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ABSTRACT

Recently, some researchers are considering the effects of classroom environment on student achievement and attitudes. Due to the concerted effort of a number of educators, remarkable progress has been made over the last quarter of a century in conceptualizing, assessing and researching this area of concern. However, today there is growing concern that research in science laboratories has not been comprehensive enough to make conclusions regarding the effects of the science laboratory environment on student learning. In an effort to fill this chasm in our knowledge, this document focuses on a questionnaire designed to aid teachers in assessing students' perceptions of their science laboratory environment. It is hoped that science teachers will make use of the classroom environment instrument accompanying this article to evaluate new curricula or teaching methods, and to check whether the classroom is seen differently by students of different genders, abilities, ethnic backgrounds, or other environmental influences. (ZWH)

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National Key Centre for School Science and Mathematics

What Research Says to the Science and Mathematics Teacher Number 8

ED 369 657

# ASSESSING THE CLIMATE OF SCIENCE LABORATORY CLASSES

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LABORATORY TEACHING is one of the unique features of education in the sciences, but there is a questioning of whether the great expense of maintaining and staffing laboratories is really justified (Hofstein & Lunetta, 1982), and whether or not many of the aims of laboratory teaching could be pursued more effectively and at less cost in non-laboratory settings (Pickering, 1980). Students' reactions to practical work often confirm the views of critics.

But, because research has not been comprehensive, we simply do not know enough about the effects of laboratory instruction upon student learning and attitudes. Consequently, it was timely to initiate the new line of research described here to help us obtain feedback about students' views of laboratory settings and to investigate the impact of laboratory classes on student outcomes.

Although classroom environment is a subtle concept, remarkable progress has been made over the last quarter of a century in conceptualizing, assessing and researching it. This research has attempted to answer many questions of interest to science teachers. Does a classroom's environment affect student achievement and attitudes? Can teachers conveniently assess the climates of their own classrooms and can they change these environments? Do teachers and their students perceive the same classroom environments similarly? What is the impact of a new curriculum or teaching method on classroom environment? These questions represent the thrust of the work on classroom environments over the past 25 years (see Fraser, 1986; Fraser, 1989b; Fraser & Walberg, 1991).

Because of the importance of classroom environment, Issue 2 of *What Research Says to the Science and Mathematics Teacher* (Fraser, 1989a) was devoted to describing the *My Class Inventory* and to showing how teachers can use it to assess and improve the climate of their classrooms.

The present publication complements the previous one by focussing on a questionnaire designed especially for science laboratory classes. In particular, a description is given here of a convenient questionnaire which can be used by teachers to obtain a quick and easy assessment of their students' perceptions of their science laboratory classroom environment. A complete copy



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of this questionnaire, in a form that may be reproduced by teachers for use in their own classrooms, is provided as lift-out Supplements A and B. In addition, a description is given of scoring procedures and potentially useful applications of the new instrument.

## SCIENCE LABORATORY ENVIRONMENT INVENTORY (SLEI)

SUPPLEMENTS A AND B contain two forms of the new questionnaire, called the *Science Laboratory Environment Inventory (SLEI)*, which is well-suited for use at the upper secondary and higher education levels. It is important to note that the SLEI is intended for use in situations in which a separate laboratory class exists.

The SLEI is economical in that it measures five different dimensions, yet it contains only 35 items altogether. Therefore, printing and collation costs are minimized. Also, because many teachers do not have ready access to computerized scoring methods, the SLEI has been designed to enable easy hand scoring.

***The SLEI has been designed to enable easy hand scoring.***

The response alternatives for each item are *Almost Never, Seldom, Sometimes, Often* and *Very Often*. The scoring direction is reversed for approximately half of the items. Students' answers are recorded on the questionnaire itself to avoid errors that can arise in transferring responses to a separate answer sheet.

The items shown in Supplements A and B are arranged in cyclic order and in blocks of five to enable ready hand scoring. The first item in each block assesses Student Cohesiveness (SC); the second item in each block assesses Open-Endedness (OE); the third item assesses Integration (I); the fourth item assesses Rule Clarity (RC); and the last item in each block assesses Material Environment (ME). The meaning of these scales is clarified in Table 1 which contains a scale description and a sample item for each dimension.

### Actual and Preferred Forms

In addition to a form which measures perceptions of *actual* environment, the SLEI has an additional form which measures *preferred* environment. The preferred form is concerned with goals and value orientations as it measures perceptions of the environment ideally liked or preferred. Although item wording is almost identical for actual and preferred forms, the directions for answering the two forms instruct students clearly as to whether they are rating what their class is actually like or what they would prefer it to be like. Supplement A contains the actual form and Supplement B contains the preferred form. It can be seen that an item such as "I work cooperatively in laboratory sessions" in the actual form is changed to "I *would* work cooperatively in laboratory sessions" in the preferred form.

### Personal vs. Class Versions

Fraser and Tobin (1991) point out that there is potentially a major problem with nearly all existing classroom environment instruments when they are used to identify differences between subgroups within a classroom (e.g., boys and girls) or in the construction of case studies of individual students. The problem is that items in most scales are worded to obtain an individual student's perceptions of the class as a whole, as distinct from that student's perceptions of his/her own role within the classroom. Although such classroom environment scales have been used to advantage in case study research (Tobin, Kahle & Fraser, 1990), these studies underline the desirability of having a new version of instruments available which are better suited to identifying differences.

For the reasons above, we developed a personal version of the SLEI which parallels its class version. Whereas Fraser, Giddings and McRobbie (1991) contains both the class and personal versions of the SLEI, it is the personal form which provides the focus for the present publication and which is provided in Supplements A and B.

## Scoring

In order to score some of the items, the responses *Almost Never*, *Seldom*, *Sometimes*, *Often* and *Very Often* are given the scores of *1*, *2*, *3*, *4* and *5*, respectively. But, for the items with *R* in the *For Teacher's Use* column, reverse scoring is used so that *5* is given for *Almost Never* and *1* is given for *Very Often*, etc. Omitted or incorrectly answered items are given a score of *3*. The score for each of the 35 individual items can be written in the *For Teacher's Use* column.

The total score for a particular scale is simply obtained by adding the scores for the five items belonging to that scale. For example, the Student Cohesiveness scale total is obtained by adding the scores given to Items 1, 6, 11, 16, 21, 26 and 31, whereas the Material Environment total is the sum of the scores obtained for the last item in each block. The bottom of the questionnaire provides some spaces where the teacher can record the student's total score for each scale. Figure 1 shows how the questionnaire was scored to obtain a total of *23* for the Student Cohesiveness scale and *19* for the Material Environment scale.

## Initial Development

The initial development of the SLEI was guided by the following criteria. A review of the literature was undertaken to identify dimensions that were considered important

*TABLE 1. Descriptive Information for Each Scale*

| Scale Name | Description | Sample Item |
|---|---|---|
| Student Cohesiveness | Extent to which students know, help and are supportive of one another. | I get along well with students in this laboratory class. (+) |
| Open-Endedness | Extent to which the laboratory activities emphasize an open-ended divergent approach to experimentation. | In my laboratory sessions, the teacher decides the best way for me to carry out the laboratory experiments. (-) |
| Integration | Extent to which the laboratory activities are integrated with non-laboratory and theory classes. | I use the theory from my regular science class sessions during laboratory activities. (+) |
| Rule Clarity | Extent to which behaviour in the laboratory is guided by formal rules. | There is a recognized way for me to do things safely in this laboratory. (+) |
| Material Environment | Extent to which the laboratory equipment and materials are adequate. | I find that the laboratory is crowded when I am doing experiments. (-) |

\+ Items designated (+) are scored 1, 2, 3, 4 and 5, respectively, for the responses Almost Never, Seldom, Sometimes, Often and Very Often.

\- Items designated (-) are scored 5, 4, 3, 2 and 1, respectively, for the responses Almost Never, Seldom, Sometimes, Often and Very Often.

*FIGURE 1. Illustration of Hand Scoring Procedures*

| *Remember that you are describing your **actual** classroom.* | Almost Never / Seldom / Sometimes / Often / Very Often | For Teacher's Use |
|---|---|---|
| 1. I get on well with students in this laboratory class. | 1 2 3 4 (5) | 5 |
| 2. There is opportunity for me to pursue my own science interests in this laboratory class. | 1 2 3 4 5 | |
| 3. What I do in our regular science class is unrelated to my laboratory work. | 1 2 3 4 5 | R |
| 4. My laboratory class has clear rules to guide my activities. | 1 2 3 4 5 | |
| 5. I find that the laboratory is crowded when I am doing experiments. | 1 2 3 4 (5) | R 1 |
| 6. I have little chance to get to know other students in this laboratory class. | (1) 2 3 4 5 | R 5 |
| 7. In this laboratory class, I am required to design my own experiments to solve a given problem. | 1 2 3 4 5 | |
| 8. The laboratory work is unrelated to the topics that I am studying in my science class. | 1 2 3 4 5 | R |
| 9. My laboratory class is rather informal and few rules are imposed on me. | 1 2 3 4 5 | R |
| 10. The equipment and materials that I need for laboratory activities are readily available. | 1 (2) 3 4 5 | 2 |
| 11. Members of this laboratory class help me. | 1 2 3 (4) 5 | 4 |
| 12. In my laboratory sessions, other students collect different data than I do for the same problem. | 1 2 3 4 5 | |
| 13. My regular science class work is integrated with laboratory activities. | 1 2 3 4 5 | |
| 14. I am required to follow certain rules in the laboratory. | 1 2 3 4 5 | |
| 15. I am ashamed of the appearance of this laboratory. | 1 2 (3) 4 5 | R 3 |
| 16. I get to know students in this laboratory class well. | 1 (2) 3 4 5 | 2 |
| 17. I am allowed to go beyond the regular laboratory exercise and do some experimenting of my own. | 1 2 3 4 5 | |
| 18. I use the theory from my regular science class sessions during laboratory activities. | 1 2 3 4 5 | |
| 19. There is a recognized way for me to do things safely in this laboratory. | 1 2 3 4 5 | |
| 20. The laboratory equipment which I use is in poor working order. | 1 (2) 3 4 5 | R 4 |
| 21. I am able to depend on other students for help during laboratory classes. | 1 2 (3) 4 5 | 3 |
| 22. In my laboratory sessions, I do different experiments than some of the other students. | 1 2 3 4 5 | |
| 23. The topics covered in regular science class work are quite different from topics with which I deal in laboratory sessions. | 1 2 3 4 5 | R |
| 24. There are few fixed rules for me to follow in laboratory sessions. | 1 2 3 4 5 | R |
| 25. I find that the laboratory is hot and stuffy. | 1 2 3 (4) 5 | R 2 |
| 26. It takes me a long time to get to know everybody by his/her first name in this laboratory class. | 1 2 3 (4) 5 | R 2 |
| 27. In my laboratory sessions, the teacher/instructor decides the best way for me to carry out the laboratory experiments. | 1 2 3 4 5 | R |
| 28. What I do in laboratory sessions helps me to understand the theory covered in regular science classes. | 1 2 3 4 5 | |
| 29. The teacher/instructor outlines safety precautions to me before my laboratory sessions commence. | 1 2 3 4 5 | |
| 30. The laboratory is an attractive place for me to work in. | 1 (2) 3 (4) 5 | 3 |
| 31. I work cooperatively in laboratory sessions. | 1 (2) 3 4 5 | 2 |
| 32. I decide the best way to proceed during laboratory experiments. | 1 2 3 4 5 | |
| 33. My laboratory work and regular science class work are unrelated. | 1 2 3 4 5 | R |
| 34. My laboratory class is run under clearer rules than my other classes. | 1 2 3 4 5 | |
| 35. My laboratory has enough room for individual or group work. | 1 2 3 (4) 5 | 4 |

For Teacher's Use Only: SC 23 OE _____ I _____ RC _____ ME 19

# SCIENCE LABORATORY ENVIRONMENT INVENTORY (SLEI)

## ACTUAL FORM

**Directions**

This questionnaire contains statements about practices which could take place in this laboratory class. You will be asked **how often** each practice **actually takes place.**

There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Think about how well each statement describes what this laboratory class is actually like for you. Draw a circle around

| | | |
|---|---|---|
| 1 | if the practice actually takes place | ALMOST NEVER |
| 2 | if the practice actually takes place | SELDOM |
| 3 | if the practice actually takes place | SOMETIMES |
| 4 | if the practice actually takes place | OFTEN |
| 5 | if the practice actually takes place | VERY OFTEN |

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

**Practice Example**. Suppose that you were given the statement: "I choose my partners for laboratory experiments." You would need to decide whether you thought that you **actually** choose your partners *Almost Never*, *Seldom*, *Sometimes*, *Often* or *Very Often*. For example, if you selected *Very Often*, you would circle the number 5 on your Answer Sheet.

Don't forget to write your name and other details at the top of the reverse side of this page.

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This page is a supplement to a publication entitled *Assessing the Climate of Science Laboratory Classes* authored by Barry J. Fraser, Geoffrey J. Giddings and Campbell J. McRobbie and published by the Key Centre for School Science and Mathematics at Curtin University of Technology, Perth, Australia.

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NAME _____ SCHOOL _____ CLASS _____

| *Remember that you are describing your **actual** classroom.* | Almost Never / Seldom / Sometimes / Often / Very Often | For Teacher's Use |
|---|---|---|
| 1. I get on well with students in this laboratory class. | 1 2 3 4 5 | ____ |
| 2. There is opportunity for me to pursue my own science interests in this laboratory class. | 1 2 3 4 5 | ____ |
| 3. What I do in our regular science class is unrelated to my laboratory work. | 1 2 3 4 5 | R ____ |
| 4. My laboratory class has clear rules to guide my activities. | 1 2 3 4 5 | ____ |
| 5. I find that the laboratory is crowded when I am doing experiments. | 1 2 3 4 5 | R ____ |
| 6. I have little chance to get to know other students in this laboratory class. | 1 2 3 4 5 | R ____ |
| 7. In this laboratory class, I am required to design my own experiments to solve a given problem. | 1 2 3 4 5 | ____ |
| 8. The laboratory work is unrelated to the topics that I am studying in my science class. | 1 2 3 4 5 | R ____ |
| 9. My laboratory class is rather informal and few rules are imposed on me. | 1 2 3 4 5 | R ____ |
| 10. The equipment and materials that I need for laboratory activities are readily available. | 1 2 3 4 5 | ____ |
| 11. Members of this laboratory class help me. | 1 2 3 4 5 | ____ |
| 12. In my laboratory sessions, other students collect different data than I do for the same problem. | 1 2 3 4 5 | ____ |
| 13. My regular science class work is integrated with laboratory activities. | 1 2 3 4 5 | ____ |
| 14. I am required to follow certain rules in the laboratory. | 1 2 3 4 5 | ____ |
| 15. I am ashamed of the appearance of this laboratory. | 1 2 3 4 5 | R ____ |
| 16. I get to know students in this laboratory class well. | 1 2 3 4 5 | ____ |
| 17. I am allowed to go beyond the regular laboratory exercise and do some experimenting of my own. | 1 2 3 4 5 | ____ |
| 18. I use the theory from my regular science class sessions during laboratory activities. | 1 2 3 4 5 | ____ |
| 19. There is a recognized way for me to do things safely in this laboratory. | 1 2 3 4 5 | ____ |
| 20. The laboratory equipment which I use is in poor working order. | 1 2 3 4 5 | R ____ |
| 21. I am able to depend on other students for help during laboratory classes. | 1 2 3 4 5 | ____ |
| 22. In my laboratory sessions, I do different experiments than some of the other students. | 1 2 3 4 5 | ____ |
| 23. The topics covered in regular science class work are quite different from topics with which I deal in laboratory sessions. | 1 2 3 4 5 | R ____ |
| 24. There are few fixed rules for me to follow in laboratory sessions. | 1 2 3 4 5 | R ____ |
| 25. I find that the laboratory is hot and stuffy. | 1 2 3 4 5 | R ____ |
| 26. It takes me a long time to get to know everybody by his/her first name in this laboratory class. | 1 2 3 4 5 | R ____ |
| 27. In my laboratory sessions, the teacher decides the best way for me to carry out the laboratory experiments. | 1 2 3 4 5 | R ____ |
| 28. What I do in laboratory sessions helps me to understand the theory covered in regular science classes. | 1 2 3 4 5 | ____ |
| 29. The teacher outlines safety precautions to me before my laboratory sessions commence. | 1 2 3 4 5 | ____ |
| 30. The laboratory is an attractive place for me to work in. | 1 2 3 4 5 | ____ |
| 31. I work cooperatively in laboratory sessions. | 1 2 3 4 5 | ____ |
| 32. I decide the best way to proceed during laboratory experiments. | 1 2 3 4 5 | ____ |
| 33. My laboratory work and regular science class work are unrelated. | 1 2 3 4 5 | R ____ |
| 34. My laboratory class is run under clearer rules than my other classes. | 1 2 3 4 5 | ____ |
| 35. My laboratory has enough room for individual or group work. | 1 2 3 4 5 | ____ |

For Teacher's Use Only: SC _____ OE _____ I _____ RC _____ ME _____

SUPPLEMENT B

# SCIENCE LABORATORY ENVIRONMENT INVENTORY (SLEI)

## PREFERRED FORM

**Directions**

This questionnaire contains statements about practices which could take place in this laboratory class. You will be asked **how often** you would **prefer** each practice to take place.

There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Think about how well each statement describes what your preferred laboratory class is like. Draw a circle around

| | | |
|---|---|---|
| 1 | if you would prefer the practice to take place | ALMOST NEVER |
| 2 | if you would prefer the practice to take place | SELDOM |
| 3 | if you would prefer the practice to take place | SOMETIMES |
| 4 | if you would prefer the practice to take place | OFTEN |
| 5 | if you would prefer the practice to take place | VERY OFTEN |

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

**Practice Example**. Suppose that you were given the statement: "I would choose my partners for laboratory experiments." You would need to decide whether you thought that you would **prefer** to choose your partners *Almost Never*, *Seldom*, *Sometimes*, *Often* or *Very Often*. For example, if you selected *Very Often*, you would circle the number 5 on your Answer Sheet.

Don't forget to write your name and other details at the top of the reverse side of this page.

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NAME _____ SCHOOL _____ CLASS _____

| *Remember that you are describing your **preferred** classroom.* | Almost Never Seldom Sometimes Often Very Often | For Teacher's Use |
|---|---|---|
| 1. I would get on well with students in this laboratory class. | 1 2 3 4 5 | ____ |
| 2. There would be opportunity for me to pursue my own science interests in this laboratory class. | 1 2 3 4 5 | ____ |
| 3. What I do in our regular science class would be unrelated to my laboratory work. | 1 2 3 4 5 | R ____ |
| 4. My laboratory class would have clear rules to guide my activities. | 1 2 3 4 5 | ____ |
| 5. I would find that the laboratory is crowded when I am doing experiments. | 1 2 3 4 5 | R ____ |
| 6. I would have little chance to get to know other students in this laboratory class. | 1 2 3 4 5 | R ____ |
| 7. In this laboratory class, I would be required to design my own experiments to solve a given problem. | 1 2 3 4 5 | ____ |
| 8. The laboratory work would be unrelated to the topics that I am studying in my science class. | 1 2 3 4 5 | R ____ |
| 9. My laboratory class would be rather informal and few rules would be imposed on me. | 1 2 3 4 5 | R ____ |
| 10. The equipment and materials that I need for laboratory activities would be readily available. | 1 2 3 4 5 | ____ |
| 11. Members of this laboratory class would help me. | 1 2 3 4 5 | ____ |
| 12. In my laboratory sessions, other students would collect different data than I would for the same problem. | 1 2 3 4 5 | ____ |
| 13. My regular science class work would be integrated with laboratory activities. | 1 2 3 4 5 | ____ |
| 14. I would be required to follow certain rules in the laboratory. | 1 2 3 4 5 | ____ |
| 15. I would be ashamed of the appearance of this laboratory. | 1 2 3 4 5 | R ____ |
| 16. I would get to know students in this laboratory class well. | 1 2 3 4 5 | ____ |
| 17. I would be allowed to go beyond the regular laboratory exercise and do some experimenting of my own. | 1 2 3 4 5 | ____ |
| 18. I would use the theory from my regular science class sessions during laboratory activities. | 1 2 3 4 5 | ____ |
| 19. There would be a recognized way for me to do things safely in this laboratory. | 1 2 3 4 5 | ____ |
| 20. The laboratory equipment which I use would be in poor working order. | 1 2 3 4 5 | R ____ |
| 21. I would be able to depend on other students for help during laboratory classes. | 1 2 3 4 5 | ____ |
| 22. In my laboratory sessions, I would do different experiments than some of the other students. | 1 2 3 4 5 | ____ |
| 23. The topics covered in regular science class work would be quite different from topics with which I deal in laboratory sessions. | 1 2 3 4 5 | R ____ |
| 24. There would be few fixed rules for me to follow in laboratory sessions. | 1 2 3 4 5 | R ____ |
| 25. I would find that the laboratory is hot and stuffy. | 1 2 3 4 5 | R ____ |
| 26. It would take me a long time to get to know everybody by his/her first name in this laboratory class. | 1 2 3 4 5 | R ____ |
| 27. In my laboratory sessions, the teacher would decide the best way for me to carry out the laboratory experiments. | 1 2 3 4 5 | R ____ |
| 28. What I do in laboratory sessions would help me to understand the theory covered in regular science classes. | 1 2 3 4 5 | ____ |
| 29. The teacher would outline safety precautions to me before my laboratory sessions commence. | 1 2 3 4 5 | ____ |
| 30. The laboratory would be an attractive place for me to work in. | 1 2 3 4 5 | ____ |
| 31. I would work cooperatively in laboratory sessions. | 1 2 3 4 5 | ____ |
| 32. I would decide the best way to proceed during laboratory experiments. | 1 2 3 4 5 | ____ |
| 33. My laboratory work and regular science class work would be unrelated. | 1 2 3 4 5 | R ____ |
| 34. My laboratory class would be run under clearer rules than my other classes. | 1 2 3 4 5 | ____ |
| 35. My laboratory would have enough room for individual or group work. | 1 2 3 4 5 | ____ |

For Teacher's Use Only: SC _____ OE _____ I _____ RC _____ ME _____

in the unique environment of the science laboratory class. Guidance in identifying dimensions also was obtained by examining all scales contained in existing classroom environment instruments for non-laboratory settings (Fraser, 1986). By interviewing numerous science teachers and students at the upper secondary and university levels and asking them to comment on draft versions of sets of items, an attempt was made to ensure that the SLEI's dimensions and individual items were considered salient by teachers and students. In order to achieve economy in terms of the time needed for answering and scoring, the SLEI was designed to have a relatively small number of reliable scales, each containing a fairly small number of items.

## VALIDITY AND RELIABILITY

A SET OF ITEMS was written and passed through several successive revisions based on reactions solicited from colleagues with expertise in questionnaire construction and science teaching at the secondary and higher education levels. Careful attention was paid to making each item suitable for measuring both actual and preferred classroom environment. A series of item and factor analyses reported by Fraser, Giddings and McRobbie (1991) was used to improve the preliminary form and obtain the 35-item final form described in this publication.

Information about the reliability of SLEI scales is reported by Fraser, Giddings and McRobbie (1991) for the Australia-only sample, consisting of 1 875 senior high school students and 298 university students, described in Table 2. As well, reliability has been estimated for the larger six-country sample (Australia, USA, Canada, England, Israel, Nigeria) of 3 727 senior high school students and 1 720 university students also described in Table 2. Both the actual and preferred forms were administered to these samples.

*TABLE 2. Description of Australian and Six-Country Samples of School and University Students*

| Schools/ Universities | Country | Sample Size | |
|---|---|---|---|
| | | Students | Classes |
| Schools | Australia only | 1 875 | 111 |
| | All 6 countries combined | 3 727 | 198 |
| Universities | Australia only | 298 | 24 |
| | All 6 countries combined | 1 720 | 71 |

When the actual form of the SLEI shown in Supplement A was administered to a new sample consisting of 516 senior high school chemistry students in 56 classes in Queensland, reliabilities (alpha coefficients) for class means were 0.80 for Student Cohesiveness, 0.80 for Open-Endedness, 0.91 for Integration, 0.76 for Rule Clarity and 0.74 for Material Environment. Similar values for the reliability occurred for the preferred form of the SLEI for the Australian sample, and for both the actual and preferred forms for the six-country samples described previously. These values indicate that the SLEI has satisfactory reliability for scales containing only seven items each.

## USES OF SLEI

FRASER (1989a) has proposed a simple approach by which teachers can use information obtained from classroom environment questionnaires to guide attempts to improve their classrooms. The basic approach involves three aspects. First, assessments of student perceptions of both their actual and preferred classroom environment are used to identify differences between the actual classroom environment and that preferred by students. Second, strategies aimed at reducing these differences are implemented. Third, the

classroom environment scales can be readministered to assess the success of the strategies in promoting changes. It is recommended that science teachers use this strategy in conjunction with the SLEI in attempts at improving laboratory class environments.

In particular, the proposed method for improving the climate of science laboratory classes can be especially useful as a basis for school-based staff development. Experience has shown that the administration and scoring of the SLEI can provide an excellent foundation for stimulating fruitful discussion and guiding improvement attempts as part of school-based professional development initiatives.

In past classroom environment research, it has been common to investigate associations between student outcomes and the nature of the classroom environment (Fraser, 1986). In order to permit investigation of the predictive validity (i.e., the ability to predict student outcomes) of the actual form of the SLEI, a large sample of Australian senior high school students responded to some scales which assessed attitudes toward science. Generally, the dimensions of the SLEI were found to be positively related with student attitude scores (Fraser, Giddings & McRobbie, 1991). In particular, students' attitude scores were higher in classrooms in which students perceived the presence of greater student cohesiveness, integration and rule clarity and a better material environment.

Previously, both researchers and teachers have found it useful to employ classroom climate dimensions as criteria of effectiveness in the evaluation of innovations, new curricula and new teaching methods (Fraser, 1986). Because of the high cost of laboratory teaching and the doubts expressed about its effectiveness, it is desirable that science teachers make use of the SLEI to monitor students' views of their laboratory classes, investigate the impact that different laboratory environments have on student outcomes, and provide a basis for guiding systematic attempts to improve these learning environments.

***Teachers are likely to see their science laboratory classes 'through rose-coloured glasses'.***

In previous research in several countries, students' and teachers' perceptions were compared. It has been found that, first, both students and teachers preferred a more positive classroom environment than they perceived as being actually present and, second, teachers tended to perceive the classroom environment more positively than did their students in the same classrooms. These findings have been replicated for the SLEI (Giddings & Fraser, 1990). These results are important because they suggest that teachers are likely to see their science laboratory classes 'through rose-coloured glasses' in the sense that teachers' perceptions typically are more positive than their students' perceptions.

## CONCLUSION

THIS PUBLICATION describes a new questionnaire for assessing the climate of science laboratory classes either at the senior high school or the university level. A major purpose in producing this publication is to encourage science teachers to assess the environments of their own laboratory classrooms. Because classroom environment instruments can provide meaningful information about classrooms and a tangible basis to guide improvements, an economical, easily-administered, hand-scorable questionnaire is provided as part of this publication. Hopefully science teachers will make use of this classroom environment instrument in evaluating new curricula or teaching methods, checking whether the same classroom is seen differently by

students of different genders, abilities or ethnic backgrounds, etc.

Noteworthy features of the SLEI include its consistency with the literature, its specific relevance to science laboratory classes and its salience to science teachers and students. Also, the SLEI has a personal version (involving a student's perception of his/her own role in the classroom), in contrast to most other existing instruments which exist only in a class version (involving a student's perceptions of the class as a whole).

A major limitation of most past research which has investigated differences in the environment scores of different subgroups of students within a class (e.g., students varying in gender, ethnicity or socioeconomic status), is that the traditional class version of instruments is not ideally suited to this research aim. Consequently, the existence of a personal version of the SLEI opens up the possibility of conducting more meaningful and sensitive investigations of the environments existing within a class for different subgroups of students.

## REFERENCES

Fraser, B.J. (1986). *Classroom environment*. London: Croom Helm.

Fraser, B.J. (1989a). *Assessing and improving classroom environment* (What Research Says to the Science and Mathematics Teacher No. 2). Perth: Key Centre for School Science and Mathematics, Curtin University of Technology.

Fraser, B.J. (1989b). Twenty years of classroom climate work: Progress and prospect. *Journal of Curriculum Studies*, 21, 207-327.

Fraser, B.J., Giddings, G.J. & McRobbie, C.J. (1991, April). Science laboratory classroom environments: A cross-national perspective. Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Fraser, B. & Tobin, K. (1991). Combining qualitative and quantitative methods in the study of learning environments. In B.J. Fraser and H.J. Walberg (Eds.), *Educational environments: Evaluation, antecedents and consequences*. Oxford: Pergamon Press.

Fraser, B.J. & Walberg, H.J. (Eds.). (1991). *Educational environments: Evaluation, antecedents and consequences*. Oxford: Pergamon Press.

Giddings, G.J. & Fraser, B.J. (1990, April). Cross-national development, validation and use of an instrument for assessing the environment of science laboratory classes. Paper presented at the annual meeting of the American Educational Research Association, Boston.

Hofstein, A. & Lunetta, V. (1982). The role of the laboratory in science teaching: Neglected areas of research. *Review of Educational Research*, 52, 201-207.

Pickering, M. (1980). Are laboratory courses a waste of time? *The Chronicle of Higher Education*, 19, 44-50.

Tobin, K., Kahle, J.B. & Fraser, B.J. (Eds.). (1990). *Windows into science classes: Problems associated with higher-level cognitive learning*. London: Falmer Press.

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